Shanghai International Port (Group) Co., Ltd (SIPG) is the first joint-stock port enterprise to be wholly listed in China, with specialization in cargo handling of containers, bulk/breakbulk and automobiles, port logistics, with related services including pilotage, towing, tallying, feeder, warehousing, forwarding, trucking and international cruises. SIPG's flagship facility, Shanghai Port, recorded a throughput of 36.54 million TEU in 2015 and is ranked as the top globally.

SIPG's vision is to become a globally leading port operator and port logistics services provider, and is committed to the development of Shanghai as the international shipping center, facilitating global trade and development. SIPG also strives for being an operator of "connected, green, technological and efficient port", and facilitate the upgrading transformation of the port functions, realizing sustainable development.

SIPG cooperates with partners in optimizing ports and supply chain logistics, aiming continuous enterprise growth, customer service value enhancement, and positive contribution to both the society and the larger economy.

For more information about SIPG, please visit its corporate homepage www.portshanghai.com.cn

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Foreword

Premier Li Keqiang has emphasized the importance of “supply-side reform” (and “sector upgrading” in particular) to the “Made in China 2025” plan, which is focused on innovation-driven growth and intelligence-driven transformation.

As one of the pillars of China’s supply-side infrastructure, the country’s port industry has a key role to play, and “Connected Port” present great opportunities for realizing the transformational development that is being targeted. From now on, the industry must pursue innovation by repositioning itself, redefining business models for platform economics and leveraging the internet in new ways.

This whitepaper, jointly prepared with Accenture, has the principles of open innovation and value creation at its heart. By setting out a blueprint for “Connected Port” development, it serves as a point of reference for both sector participants and related authorities, helping them to overcome difficulties on the road to the “new port economy”.

Chen Xuyuan
Chairman, Shanghai International Port (Group) Co., Ltd.

Over the past 25 years, Accenture has been delivering high performance by creating value for its clients in China.

Amid the new normal in the Chinese economy, Accenture has been steadfast in helping the Chinese government and enterprises enhance the quality and benefits of economic growth, promote upgrading and transformation, and improve their sustainability and competitiveness in the global arena. We leverage not only our knowledge, unique perspectives and insights, but also our rich local experience and global resources.

With deep experience in the global port and shipping industries gathered over the years, we feel obligated to join hands with leading enterprises and assist them in reaching new heights.

A connected port represents the future path of port development. We are honored to jointly conduct in-depth research on the topic with Shanghai International Port (Group) Co., Ltd. (SIPG). We hope our insights and suggestions will help enterprises that are aspiring for performance excellence.

Chuan Neo Chong
Senior Managing Director and Chairman, Accenture Greater China

“Connected Port” look ahead to a systematic port ecosystem, seamlessly integrated with the internet, and enabled by the Internet of Things and port automation. It presents a vision of the future of port development in China – and the multiple possibilities and opportunities that will arise.

The advent of technology have already rendered “connected Port” a reality. To transform itself, the port industry should shift its strategic focus from mere resource control to refined resource management, from optimization of internal processes to external interactivity, and from maximizing customer value to maximizing the value of the overall ecosystem.

The joint research with Accenture on “Connected Port” covers both technological applications and service innovation, designed to provide a blueprint for all the stakeholders of the port ecosystem for mutual development and benefits in the future.

Yan Jun
CEO, Shanghai International Port (Group) Co., Ltd.

Ports play an important role in international trade. The current strategic positioning of ports is significantly different than it was two decades ago, and the standards of their operations and management are far higher. Also, the global competitive landscape for ports has undergone significant changes. All the major ports in the world have witnessed a transition from extensive growth to intensive growth. With the commercialization of port operation, management has become increasingly transparent. Improving port operation is no longer the sole or main area in which to seek or gain competitive advantages.

The connected port is not a new concept. Advanced ports around the world, including Hamburg, Rotterdam, Singapore, Dubai and Shanghai, are exploring transformation opportunities by using an increasing number of online platforms.

To facilitate the transformation, ports should effectively utilize digital technologies and strengthen inter- and intra-industrial cooperation, transforming themselves into ports characterized by three Es: excellent in operation, extensive in the ecosystem and explorative in innovation.

The transformation of business models and innovation are imperative for all major ports worldwide in order to leverage rare opportunities for development. We hope that the research report will provide a new way of thinking and point a way forward for professionals in the port industry and participants in the port ecosystem.

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Chapter 1
Ports in an era of transformation
Chapter 1
Ports in an era of transformation
The trend toward upgrading and transformation

Technological innovation and division of labor had a significant impact on the port industry. A large number of factories emerged after the bourgeois revolution in the seventeenth century, leading to a rapid increase in trade handled by ports. This period was marked by the emergence of shipping companies and specialized port operators, such as the East India Company. Later, during the Second World War, Elizabeth Quay in New York City was equipped with bridge cranes, paving the way for the era of containers.

Thereafter, ports evolved from trade centers to logistics hubs. As globalization deepens, ports have begun to be more closely connected to their catchment areas, highlighting their core value proposition of promoting trade. Modern ports took shape in the twentieth century: technological innovation, lax regulatory control and logistics integration brought new driving forces. In some countries, to improve efficiency and reduce fiscal burden, ports have been entrusted to professional port operators. Port operators have begun to emerge and expand.

Homogenous competition among port operators is an increasing concern amid the current economic downturn, and is forcing operators to refocus on value innovation. The business model of seeking competitive advantages and profitable growth by focusing on just loading and unloading services is no longer sustainable. All major ports worldwide have begun to explore upgrading and transformation initiatives to create differentiated value propositions and gain competitive advantages.

The upgrading and transformation of a port involves:

- Intelligent operation—Singapore's Next Generation Port 2030 Plan highlights that the port will be efficient, intelligent, safe and secure, as well as ‘green’ and community oriented. Intelligent inland logistics—Rotterdam’s interconnected information hub, the Portbase Port Community System, capitalizes on inland transportation networks and offers a one-stop shop for logistics information exchange.

- Coordinated development of connected ports and smart cities—Germany’s Port of Hamburg serves the important economic, social and ecological functions of a city. As part of the smart city, the port has formulated a tidal energy use and sediment management plan for Elbe river; built safe and energy-saving intelligent roads in its neighbor areas; and taken measures to reduce carbon emissions and build innovative infrastructure facilities.

- Sluggish trade compels participants to transform themselves

Global gross domestic product (GDP) growth is slow and trade growth is sluggish. According to the World Bank, the growth multiplier of global container cargo and GDP decreased from 4 to 2 in the period between 2007 and 2015. Alphaliner’s statistics on 400 worldwide ports show that global container throughput in 2015 grew by just 1.1 percent, which was below global GDP growth for the first time, with the GDP multiplier being less than 1.

Chen Xuyuan, Chairman, SIPG

“...we need to make the ports serve a variety of functions and play multiple roles.”

Figure 1: Transformation of a port’s role

- Port authority
- Port terminal operators
- Trade service providers

Figure 2: Global trade rate has fallen below the GDP growth rate

Source: The World Bank, Alphaliner, Accenture analysis
Note: The data for 2015 containers worldwide is from Alphaliner’s statistics on 400 ports worldwide.
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Ports are better able to withstand the economic downturn because they maintained relatively stable growth amid the global financial crisis in 2009. However, the current global economic circumstances will compel participants in the shipping and logistical ecosystem to engage in business model transformation and innovation, which may involve the restructuring and merger of shipping companies, and the construction of bigger ships.

Large terminal shippers and third-party logistics (3PL) providers are also optimizing supply chain networks in response to market demand changes. China’s manufacturing industries are relocating to the country’s central and western regions, for example, and its coastal and riverside cities are actively integrating multimodal shipping networks. Global 3PL has introduced trans-continental, multimodal shipping plans to provide more affordable logistics services. At a time when logistics service providers are attempting to provide door-to-door services, ports – the land and sea transportation hubs – need to transform themselves to eliminate bottlenecks in information, services and efficiency.

Shipping companies’ alliances weaken the bargaining power of ports

As the global economic recovery remains slow and fragile, shipping companies are faced with many challenges, including market demand contraction, overcapacity and unstable cash flows. The China Containerized Freight Index (CCFI) plummeted by around 30 percent in 2015.® Alliances between shipping companies are not a new phenomenon involving: alliances of major liners account for more than 80 percent of global shipping capacity, and command more than 50 percent of the liner markets in Asia, Europe and North America.

Shipping company alliances require ports to handle large-scale, complex distribution and inter-port coordination. These alliances are increasing carriers’ negotiating power and port operators are in a relatively passive position. Competition between ports will intensify due to the concentration of liners and the enhanced bargaining power of these alliances will make it necessary for ports to upgrade and transform, as the shipping companies themselves upgrade and make efficiency improvements.

Containerization capacity maximization necessitates upgrading of port terminals

According to Clarkson’s statistics,® as of January 2016, global container shipping capacity reached 19.74 million twenty-foot equivalent units (TEUs), of which 3.46 million TEUs were for cargo ships of 12,000 TEUs and above (an increase of 28.3 percent year-on-year).

Containerization capacity maximization will impact the profits of port terminals. Ports will be forced to upgrade infrastructure, including berths and loading and unloading equipment, to match efficiency levels and minimize the average port time of cargo vessels. Ports will also need to increase investment in heavy-duty and automated lifting equipment, and in deploying more advanced IT systems. In addition, terminal operators will need to integrate various resources to ensure efficiency during operation peaks.

Homogenous competition compels ports to seek long-term competitive advantages

The terminal operations of warehousing, trans shipments, and loading and unloading are well established and increasingly homogenous. In addition, inland areas near the ports have overpassed and ports are dealing with similar types of goods. Ports therefore increasing rely on different competitive advantage. Take hinterland logistics efficiency, for instance. The geographical scope, economic scale and development aspect of hinterlands have a direct impact on ports’ development. But most ports do not have any close collaboration with inland industries, lacking both overarching transportation network plans and specific action plans.

The maritime logistics value chain has increasingly stringent requirements for the adequacy of collection, distribution and transportation systems, transparency of logistics operations and convenience of trade. Some local governments and leading port operators have taken measures to improve relations with local cities. A “Beyond the Port” action plan for port development initiated by the Australian government, for instance, calls for the optimal design of transportation networks between ports and inland areas and for more convenient information channels and better quality services for trade activities.

Underutilization of resources and lack of collaboration impact port efficiency

In maritime logistics, the use of port terminal resources in developing and underdeveloped countries has significant scope for improvement. In the Yangtze River Delta, for instance, the attendance rate and load ratio of container trucks are 80 percent and 60 percent respectively. Ports incur approximately CNY7 billion in losses due to underutilization of resources, including inefficient plans, time-out waiting and idle running. These ports have the potential to increase handling capacity by 15 percent (based on annual average operations of 187,000 TEU for leading ports in the

Figure 3: Operations is sues for ocean cargo (an example from Southern China)
Homogenous competition compels ports to seek long-term competitive advantages

The terminal operations of warehousing, transshipments, and loading and unloading are well established and increasingly homogenous. In addition, inland areas near the ports have overlapped and ports are dealing with similar types of goods. Ports therefore increasingly lack any differentiated competitive advantage. Take hinterland logistics efficiency, for instance. The geographical scope, economic scale and development aspect of hinterlands have a direct impact on ports’ development. But most ports do not have any close collaboration with inland industries, lacking both overarching transportation network plans and specific action plans.

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Figure 3: Operations is sues for ocean cargo (an example from Southern China)
reduce annual operating costs by CNY1 billion by improving operational efficiency, and reduce operating costs by CNY1.46 billion by decreasing average port time by 10 percent.

Logistics service providers in ocean shipping are numerous and dispersed, and endeavor to minimize costs and maximize profits. However, they face challenges in terms of talent, technology and experience in industrial collaborations, all of which are necessary to improve the efficiency of the logistics value chain. As port operation and management have become increasingly commercialized, the efficiency of collection, distribution and transportation has substantially improved.

Ports seek sustainable development amid calls for environmental protection

The transportation industry consumes high levels of energy, and emits a significant amount of waste gas and greenhouse gas. In 2013, China’s port vessels discharged 588,000 tons of sulfur dioxide (approximately 8.4 percent of the total emissions from the country) and 278,000 tons of nitrogen oxides (11.3 percent of the total emissions in China). The International Convention for the Prevention of Pollution from Ships (IMARPOL) stipulates mandatory standards for sulfur and nitrogen oxide discharges both in emission control areas (ECA) and globally, requiring the sulfur content of oil used by ships worldwide to decrease from 3.5 percent in 2012 to 0.5 percent in 2020. In response to stronger calls for environmental protection, port operators are increasingly using new forms of energy and must strictly comply with regulatory policies on waste gas discharges.

Port security gains attention at a global level

In recent years, supply chain security has gained worldwide attention. In 2012, the Department of Homeland Security of the United States released its National Strategy for Global Supply Chain Security, highlighting a broad range of risks affecting global supply chains. These risks include the effects of pandemics on border crossings and workforces; earthquake disruptions to mainland routes; bombarding of major supply chain nodes; trade barriers to raw materials and specialized products; and cyber disruptions to supply chains. Each of these risks affects port terminals linking inland and ocean shipping. In addition, port security is affected by the risk management levels of participants in logistics networks.

Since ports are important collection, distribution and transportation nodes, major port security events will have broad and far-reaching effects. Port security has a direct impact on local cities, residents and even an entire nation. The 2013 World Economic Forum called for the prevention of supply chain risks and the building of resilience in supply chains, recommending the adoption of a universal risk management terminology, the strengthening of information sharing in value chains, and the formulation of more agile, flexible risk management strategies. These are equally applicable to ports.

Digital technologies are driving the transformation of port terminals

Digital technologies will be an important driver in the upgrading and transformation of ports. The “Port + Digital” model helps improve existing supply chains. Open and shared digital platforms help identify new growth areas to drive the transformation of business and operation models. International Data Corporation (IDC) predicts that by early 2016 global non-technology enterprises will have established more than 100 new digital industrial platforms.

These digital industrial platforms and ecosystems are fueling a new round of breakthrough innovation. Enterprises such as Apple and Facebook have created new platform-based business models. Using platform-centered ecosystems, these companies can join hands with their partners or developers to seize even greater opportunities and tackle even more challenging tasks.

As the third wave in the development of the global information industry, the Internet of Things closely connects port equipment with various participants, and creates vast amounts of “flowing” data. By coupling this data with big data analytics, ports will become more intelligent and able to respond to new events more quickly and effectively. More intelligent terminals will be used in port operations. Unattended port security monitoring and receipt deliveries, driverless cargo transportation, automated loading and unloading, and unmanned cargo vessels will make ports “unattended” and smarter. Amazon reduces its order execution costs by 40 percent on an average – CNY10564 million per year – by using robots at its distribution centers, for example.

In the future, ports will use sensor technologies, mobile equipment, video analysis, wireless RF technologies, drones, and 3D printing technologies extensively. More breakthroughs in network coverage, network security and energy technologies will facilitate the application of new technologies in various port operations.

Amid the new normal of economic slowdown, environmental protection requirements and port security concerns, all logistics providers in ocean shipping need to innovate and transform their business models to secure their position in the value chain. Homogenous competition impedes both alliances of shipping companies and container shipping capacity maximization. It is imperative that port operators identify new areas of growth and create sustainable competitive advantages. Terminal operators should make full use of existing technologies, including digital and automation, to break industrial barriers in the ocean shipping logistics value chain and improve efficiency in the inland logistics value chain. They should also establish sustainable innovation mechanisms, and strengthen internal and external collaboration to stimulate small and medium enterprises to innovate, in order to better meet these challenges.
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Figure 4: New technology applications in the port industry

<table>
<thead>
<tr>
<th>Technology</th>
<th>Application and value</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Internet of Things       | Monitor physical logistics flows, collect and monitor data, enable intelligent decision making, optimize processes | The Port of Hamburg uses intranets, cloud computing, mobile terminal equipment, the Internet of Things and big data technologies to manage the port area, parking lots, terminal and roads.13   
Intelligent ships reduce oil consumption and monitor shipping. |
| Drones                  | Eliminate or minimize manned operations, improve efficiency and shipping security | Ports use drones to monitor discharges; ships use drones to deliver paper documents. | Starship Technologies is testing its revolutionary self-driving delivery robots in London. |
| Driverless trucks        | Undertake standardized, process-based operations to improve efficiency | Amazon uses robots at its warehouses to manage and deliver goods.13        |
| Crewless ships           | Turn mass production into customized and distributed production | The Port of Rotterdam uses 3D printing technologies to support the maintenance and repair of parts and accessories.14 |
| Robots                  | Provide data analysis and insights, identify opportunity and risk, and maximize efficiency | The Maritime and Port Authority of Singapore integrates real-time data through a unified platform, using aggregation analysis, anomaly analysis and data mining to develop transportation monitoring tools, and monitor and detect vessel anomalies to improve port security. Through its dynamic process management program Damco Dynamic Flow Control, Damco analyzes and optimizes supply chain data, reduces logistics time and costs, and simplifies processes.15 |
| 3D printing technologies |                                                                          |                                                                          |
| Big data                 |                                                                          |                                                                          |
| Cloud computing          | Build port communities, facilitate the deal process               | Trucker Path and Cargomatic have launched apps to facilitate deal making, reduce idle transportation and improve the efficiency of trucking.16 |
Open innovation creates a new landscape for ports

Ports have traditionally relied on geographical positions and operational management to gain competitive advantages. However, intensifying homogeneous competition among ports has forced them to attach greater importance to differentiation, bring in manufacturing industries to match the logistics industry, and form industrial clusters. Unlike high-tech, manufacturing and retail companies, ports have distinctive geographical characteristics and do not directly connect terminal cargo owners. Port service and management innovation has traditionally evolved around the port itself. Some leading port managers, taking a long-term perspective, have begun to engage in investment- and innovation-related activities in hinterland areas, including the development of infrastructure facilities for transportation networks. Examples include Australia’s National Port Strategy (NPS) and Shanghai’s Yangtze River Economic Belt strategy, Rotterdam’s Port Community System and Port of Hamburg’s intelligent roadways are both examples of how ports are applying digital technology.

The most direct and effective way for traditional industries to embrace innovation is by introducing innovative forces. The trend is toward a port ecosystem that is open, interactive, highly connected, data driven and smart. Collaborations between ports, governments and research institutions are essential. Harvard Business School Professor, Henry Chesbrough introduced the “Open Innovation” concept in 2003: “Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.” Initially, open innovation took the form of crowdsourcing initiatives adopted by high-tech enterprises, pharmaceutical manufacturers, automobile manufacturers and service providers to speed up innovation. Through its “Connect + Develop” project, for instance, P&G shares research and development and consumer knowledge with governments and other enterprises to jointly improve product quality. With abundant data accumulation, broad relationship networks and enormous logistics assets, ports have huge potential for open innovation.

Figure 5: Openness and innovation to achieve interconnection in the value chain of ocean cargo

<table>
<thead>
<tr>
<th>Cargo owner</th>
<th>Hinterland transportation</th>
<th>Ocean transportation</th>
<th>Unloading</th>
<th>Hinterland transportation</th>
<th>Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected ports</td>
<td>Digitally-enabled port synchronization, import planning, resource and work flow optimization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected ships</td>
<td>Real-time monitoring, operations and availability optimization integrated with key stakeholders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected container trucks</td>
<td>Monitor in real time &amp; analyze to support better vehicle, driver, operations &amp; regulations management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connected workers</td>
<td>Mobile, safety, tracking analytics and technology to increase worker efficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E-Commerce Platforms

Real-time bookings, visibility, price transparency, customs and supplier integration with predictive analytics

Digital supply chains

End to end monitoring, analytics, automation and integration across channels and supply chain stakeholders
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Chapter 2
Connected ports of the future
“For the next generation of ports, competition will move from ‘route’ to ‘network’. Flexible and competitive supply chains will benefit various participants. The value chain will be highly interconnected; thus, digital technologies will be crucial for industrial and cross-industrial collaboration and innovation, representing a new way of thinking and new trajectory for the port ecosystem.”

Fox Chu, Managing Director, Global Ports Lead, Accenture

Digital technologies and open innovation will inject new energy into the traditional port industry and assist port operators in breaking existing industrial barriers. Over the years, port operators have been in a favorable position in the ocean shipping logistics value chain. Government funding, asset-heavy investment, relatively long construction cycles and complex operational management have been high barriers of entry in the port industry. However, times are changing. Ports need to reposition themselves against their competitors to build up new competitive strengths.

In the new round of upgrading and transformation, port operators need to address three issues:

• Balance port profitability with maritime logistics’ competitiveness in the hinterland. Ports are an important link in the maritime logistics chain, the optimal decisions made for ports may not be optimal decisions for the whole chain.

• Balance the profitability of a single port with that of the network of ports. Since it is difficult for a single port to maximize profits in homogenous competition, ports need to differentiate themselves and engage in value innovation to be better positioned.

• Balance short- and long-term profitability of ports. Transformation often involves forgoing some current interests in favor of long-term development.

The value of building a connected port

A connected port is not just about the application of new technology. It involves rethinking business models and is a practice of value innovation. This report defines a “connected port” as one in which information technologies and business model innovations enable an intelligent collection, distribution and transportation system, and drive efficiency in the operation of logistics, information and fund flows in the port ecosystem.

A connected port aims to achieve the following development goals:

• Set up a convenient, low-cost, safe and secure collection, distribution and transportation system;

• Form a closely collaborative maritime logistics ecosystem to raise the proportion of value-added services and facilitate trade;

• Establish secure, reliable, ‘green’ and sustainable ports.

The value propositions of a connected port include greater efficiency in the maritime logistics value chain, lower trade costs and enhanced reliability. Accenture and Sipo conservatively estimate that a connected port will generate significant social and economic benefits. In China’s Yangtze River Delta, for example, sea-shipped international trade amounted to around CNY8.1 trillion. Logistics costs account for around 18 percent of China’s GDP (more than half for transportation costs, approximately one-third for warehousing and storage costs, and approximately one-eighth for management costs). Connected ports are projected to reduce logistics costs by 3.6 percent, and create CNY33.8 billion of annual value for hinterland logistics. A bottom-up analysis of the effects of a connected port on the efficiencies of wharves, shipping companies and hinterland logistics shows that terminal automation and port-zone information platforms have substantially improved the efficiency of the collection, distribution and transportation system, and will generate approximately CNY223.7 billion annually in added value. In addition, intelligent information platforms and the optimization of hinterland transformation networks can reduce capital costs by approximately CNY44.5 billion and create CNY9.5 billion of trade financing annually. Automated processes, optimized energy structures, management innovation and improved IT have also all significantly enhanced the reliability of ports, and can reduce the annual discharge of sulfur dioxides and nitrogen dioxides by 61,300 tons and 70,400 tons, respectively.

Figure 6: CNY 33.8 billion annual value creation in logistics from Shanghai catchment areas (Unit: CNY)

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<thead>
<tr>
<th>Cargo Contribution</th>
<th>Transportation Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>~ 9 billion annually Additional cargo contribution through improved efficiency</td>
<td>~ 7.2 billion annually Improved truck utilization</td>
</tr>
<tr>
<td>~ 1.4 billion annually Accelerated capital turnaround through transport efficiencies</td>
<td>~ 1.3 billion annually Improved barge utilization</td>
</tr>
<tr>
<td>~ 900 million annually Accelerated capital turnaround through tax refund efficiencies</td>
<td>~ 1.8 billion annually Improved data transparency along supply chain</td>
</tr>
<tr>
<td>~ 8.8 billion annually Potential financing opportunities for cargo in transit</td>
<td>~1 billion annually Improved utilization of quayside equipment</td>
</tr>
<tr>
<td>~ 1.5 billion annually Reduction in vessel turnaround time in-terminal</td>
<td>~ 300 million annually Improved utilization of in-yard equipment</td>
</tr>
<tr>
<td></td>
<td>~ 200 million annually Improved efficiency of customs clearance</td>
</tr>
</tbody>
</table>

Based on joint research and estimation by Accenture and Sipo
The value of building a connected port

A connected port is not just about the application of new technology. It involves rethinking business models and is a practice of value innovation. This report defines a “connected port” as one in which information technologies and business model innovations enable an intelligent collection, distribution and transportation system, and drive efficiency in the operation of logistics, information and fund flows in the port ecosystem.

A connected port aims to achieve the following development goals:

- Set up a convenient, low-cost, safe and secure collection, distribution and transportation system;
- Form a closely collaborative maritime logistics ecosystem to raise the proportion of value-added services and facilitate trade;
- Establish secure, reliable, ‘green’ and sustainable ports.

The value propositions of a connected port include greater efficiency in the maritime logistics value chain, lower trade costs and enhanced reliability.

Accenture and SIPG conservatively estimate that a connected port will generate significant social and economic benefits. In China’s Yangtze River Delta, for example, sea-shipped international trade amounted to around CNY8.1 trillion.²⁹ Logistics costs account for around 18 percent of China’s GDP (more than half for transportation costs, approximately one-third for warehousing and storage costs, and approximately one-eighth for management costs). Connected ports are projected to reduce logistics costs by 3.6 percent, and create CNY33.8 billion of annual value for hinterland logistics. A bottom-up analysis of the effects of a connected port on the efficiencies of wharves, shipping companies and hinterland logistics shows that terminal automation and port-zone information platforms have substantially improved the efficiency of the collection, distribution and transportation system, and will generate approximately CNY23.7 billion annually in added value. In addition, intelligent information platforms and the optimization of hinterland transformation networks can reduce capital costs by approximately CNY4.5 billion and create CNY9.5 billion of trade financing annually. Automated processes, optimized energy structures, management innovation and improved IT have also all significantly enhanced the reliability of ports, and can reduce the annual discharge of sulfur dioxides and nitrogen dioxides by 61,300 tons and 70,400 tons, respectively.

Figure 6: CNY 33.8 billion annual value creation in logistics from Shanghai catchment areas (Unit: CNY)
Assessments of connected ports

A transition to a connected port involves a change in thinking: ports need to focus on global, rather than local, interests, and on the efficiency of the entire shipping logistics value chain rather than the port alone. In the future, competition between ports will be more complex. Increasing supply chain efficiency depends on multiple parties, and ports need key collaborators and facilitators who can realize the objectives of the entire supply chain.

A uniform assessment system that links performance of a single project and a connected port is essential in meeting the goals of a connected port. Such a connected port is essential in meeting the performance of a single project and also to the monitoring of overall performance and comparisons with other ports. Based on our definition of a connected port and ports’ development goals, ports should be assessed on six criteria: ecosystem strategy of a sharing economy; reliable and convenient customer experience; stable and intelligent operation; efficient organization and supply chain collaboration; open innovation; and information and technology for interconnectivity.

Ecosystem strategy of a sharing economy

An ecosystem is symbiotic and self-adjusting. A port’s ecosystem strategy of a sharing economy includes not only the interests of the port but also the optimization of the maritime logistics value chain as a whole, emphasizing resource sharing and closer collaboration among participants for maximizing resource utilization. This theme is closely related to other assessment criteria for connected ports, including customer experience, operation management, organization and collaboration, growth and innovation, and information and technology.

The formulators or leaders of the strategy, which may be government or the ports themselves, should be qualified for the task, authoritative and visionary among stakeholders, and highly capable of resource coordination. In addition, they should have strategic collaborations with connected ports in other countries and regions, and be capable of promoting the competitiveness and trade facilitation of connected ports in their region.

Figure 7: Assessment of connected ports

Reliable and convenient customer experience

A connected port emphasizes the experience of terminal cargo owners and logistics participants, as well as strengthening collaboration with various stakeholders, facilitating trade, and offering reliable and convenient services to terminal cargo owners. Communication will be more convenient and can take place at any time. Information provision will be more timely and transparent, and cargo owners will be able to conduct visual tracking of the logistics process. As key links in international trade, ports represent the convergence of inland logistics, information flows and cash flows. Using integrated platforms, ports can bring in leading logistics service providers, assist local logistics service providers in connecting with overseas counterparts, and provide door-to-door services to cargo owners.

Maasvlakte phase II, Netherlands Forwarding and Logistics (Fenex) have cooperated in sharing information through the Portbase system, for example, simplifying customs clearance procedures, communicating on delays and accidents, streamlining inland multimodal transportation processes and establishing portal websites to help agents choose optimal multimodal transportation plans. Improved agency and terminal operating efficiency has led to improved customer experience.20

Stable and intelligent operation

Using digital and automation technologies, a connected port can improve its operational capabilities and promote effective communication and collaboration among cargo owners, agents, shipping companies, ports and port units. Innovation in business models and the application of information technology will make the logistics value chain more interconnected and interactive, improving information transparency. Artificial intelligence technologies will create a more intelligent operational environment. These technologies will help the ports substantially improve their connection, distribution and transportation capabilities, enabling optimal use of talent and equipment resources and timely monitoring and maintenance of equipment. Using artificial intelligence, ports will be able to closely track cargo, equipment, personnel and logistics flows to intelligently identify potential risks, maintain reliable port operation, and ensure the security of local cities.

Dell has established connections with the geographical data system through the Clear View platform, for example. The system helps the company match service assignments with the location of parts and accessories, and helps clients devise timely emergency plans by taking into account storms, flight delays for the transportation of parts and accessories, and traffic congestion.21

Efficient organization and supply chain collaboration

Connected ports play the important roles of trade facilitator and collaborator in the maritime logistics value chain, having a strong capability of integrating resources and maintaining close collaboration with stakeholders. In terms of institutional cooperation, a connected port has its own well-defined win-win goals, reliable government-enterprise relationships, effective upstream and downstream customer relationship management, efficient decision-making mechanisms, flexible dispute-resolution mechanisms, and swift information sharing and connectivity.

Take the industrial clusters of the Port of London.22 The port has a convenient commercial environment, in which a large number of shipping service
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enterprises have gathered to form an industrial cluster and generate huge benefits (including overseas revenues for shipping services, tax revenues and consumption-induced contributions). Efficient organization and supply chain collaboration are also embodied in the construction of networks for the ports. Different connected ports are interconnected through both physical and information links, allowing optimal connections between shipping routes as well as between ports. Key logistics nodes are integrated through joint ventures, alliances and franchises. In addition, seamless transportation networks between connected ports and inland ports are established.

Open business innovation

Connected ports will have a strong capability to cognize, absorb and apply innovations. They maintain high levels of internal awareness of open innovation and a deep understanding of the opportunities and challenges resulting from disruptive technologies. They maintain close collaborative relations with various participants in the shipping logistics value chain, foster an open innovation environment for all participants, and ensure information is accurate, reliable and timely. In addition, connected ports can collaborate to set up a sound information transmission mechanism and a unified information exchange platform, through which the ports, shipping companies, logistics companies, and terminal cargo owners can all access a real-time overview. A connected port can trans form the fragmented data gathered from its ecosystem into effective information for improving operations.

SIPO conducts intelligent testing of equipment using Internet of Things, for instance. Sensors preinstalled in loading and unloading equipment – such as motors, final drive housing, synchronous gearboxes, cylinders, and racks – collect data on the vibration of the equipment. This data, coupled with an analysis of the quality of lubricants, enables the company to provide suggestions for the operation and timely maintenance of large loading and unloading equipment. Interconnected information platforms provide participants in the logistics value chain with business opportunities and a convenient business environment, helping them to improve profitability and promoting clusters of high-value-added industries.

Information and technology for connectivity

By leveraging advanced technologies, a connected port can achieve interconnectivity between port companies and shipping companies. A port can create a highly integrated information platform with complete data, providing open and customized services to all participants, and ensuring information is accurate, reliable and timely. In addition, connected ports can collaborate to set up a sound information transmission mechanism and a unified information exchange platform, through which the ports, shipping companies, logistics companies, and terminal cargo owners can all access a real-time overview. A connected port can transform the fragmented data gathered from its ecosystem into effective information for improving operations.
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The Port of Hamburg aims to become a "plug-in" port by installing shore power equipment and mobile charging ships for vessels to plug in to while berthing, for example. The use of shore power is estimated to help ships reduce nitrogen oxides emissions by 99 percent.

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Chapter 3
From concept to reality
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"We have forgotten to progress through reflective cycles of learning and turn experience into wisdom, and wisdom into value. Already there are entrepreneurs who see a market in the circular economy in this way. Some port cities, like Amsterdam and Rotterdam, are stimulating the emergence of innovation circles. These port communities have realized that for circular thinking, one needs entrepreneurial spirits."

Maurice Jansen, Visiting Researcher, Erasmus University Rotterdam

**Value innovation focused on building a 3E-class port**

In the future, digital, intelligent and innovative technology will help a connected port transform from a simple logistics and transport node to an open and efficient platform that can participate in the global landscape of integrated world trade. A port cannot turn into a true "trade corridor" until it optimizes its global logistics efficiency and asset utilization.

The connected port is a 3E-class port, where the 3Es represent: excelling for terminal operations, extending for ecosystem facilitation, and exploring for the new.

- **Excelling for terminal operations** means further improving operational efficiency. Automation and smart machines are adopted to achieve greater operational efficiency, and enhance and optimize inherent advantages.
- **Extending for ecosystem facilitation** means enlarging the scope of services beyond container handling. Original closed operation models will be altered, and ports will collaborate and cooperate with all upstream and downstream parties along the supplychain to completely link land and sea transport nodes, providing consignons, logistics companies, shipping companies and alliances with more valuable, high-quality services.
- **Exploring for the new means** extending a port’s business scope by fully utilizing its inherent advantages: it is in the center of the supply chain, where new business models can be developed. Growth will be driven by the collection, analysis and integration of information on all aspects of the supply chain, giving rise to industry insights.

The roll out of a 3E-class port should include five goals: automation in port operations, collaboration with the logistics sector, a platform for all in the ecosystem, popularization of logistics finance, and commercializing data service. These goals will build capacity in convenient and reliable customer experience, smart and reliable operation, efficient organization and supply chain collaboration, open business innovation, and interoperable information and technology.

**Figure 8: “3E” strategic themes for ports**

**Figure 9: The strategic themes of the 3E port**

<table>
<thead>
<tr>
<th>Excel</th>
<th>Extend</th>
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<tr>
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</tr>
<tr>
<td>Popularization of logistics finance</td>
<td>Commercializing data service</td>
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</tr>
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</table>

- **Reliable and convenient customer experience**
  - Logistics visualization
  - Logistics visualization
  - Personalized online services, such as customs clearance, refund and foreign exchange settlement

- **Smart and reliable operation**
  - Connected port scheduling
  - Multimodal transportation plan
  - Innovation in logistics transaction services, such as the consolidation center
  - Standardized asset management
  - Seamless connection with the hinterland transport network
  - Information sharing between government and enterprises
  - Real-time risk warning
  - Scenario analysis and decision making based on different logistics and financial programs
  - Real-time smart decision making and analysis based on environmental data

- **Efficient organization and supply chain collaboration**
  - Collaboration and information sharing between connected ports
  - Collaboration between ports in inland multimodal transport
  - Collaboration and information sharing between connected ports
  - Collaboration between industries
  - Collaboration between corporate innovators

- **Open business innovation**
  - Carbon footprint tracking and analysis
  - Applications of new energy sources
  - Innovation in logistics transaction services, such as reverse logistics
  - Trade risk and analysis
  - Finance industry integration, such as personalized financial products and pricing
  - Data analysis-based services, such as marketing
  - Open innovation platforms

- **Information and technology for interconnectivity**
  - Automated terminal decision making and prediction system based on automatic modeling
  - Port community system
  - Smart analysis and decision making
  - Ecosystem integration platform
  - Data integration, sharing and management
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</table>
Automation in port operations

Limited automation, idle assets, devices and human resources, information silos and structural personnel shortages hinder the operational excellence of a port. Future rises in labor costs, error rates and service instability resulting from physiological causes, dependence on knowledge transfer, and an ever-increasing focus on safe operation, all mean that smart and automated ports are an inevitable trend. Leading port operators will gain an edge by investing in infrastructure to further optimize and enhance automation productivity, while strengthening integration with the logistics ecosystem to achieve differentiation. Technology plays a key role in this change: big data analysis, mobile Internet, cloud computing and other means all contribute to optimizing terminal productivity and achieving ecosystem integration.

Connected port automation is the most important port management initiative.

Automated, smart operation can cover the whole range of port processes, including yard transport, container yard operation, gate traffic, etc. An efficiently operating terminal is the goal; the alternative can become a bottleneck and hinder other operations across the logistics chain. For an effective internal process, the port needs to focus on building capacity in two areas: the automation of smart operations (improving asset utilization, reducing labor intensity, and ensuring production safety and services stability), and a centralized view of information (tracking the operation of fleets, devices and workers on a real-time basis, analyzing bottlenecks and security, and optimizing resource allocation).

Automation of machinery operation

Port automation demands that the operation of all machinery is automated except for the main crab of the waterside crane and the handling of landside external container trucks, which are subject to remote controls. Industry-leading yard automation equipment include ASC-End, C-RMG (side), ASC-End plus bridge crane (side), auto strad, RTG and ADV. To maximize investment results, the terminal needs to integrate various different information systems as well as equipment. Data standardization and optimization of processes mean dispersed terminal resources can be united as a whole, enabling automated and optimized decisions, such as information transmission automation, process automation and vehicle automation. The automated terminal will constantly become smarter and more automatic, leading to higher efficiency and cost effectiveness.

Connected ports dispatching

In the future, connected port dispatching will be built on advances in ICT, systems engineering and artificial intelligence. Information system instructions will be seamlessly connected to the terminal’s machinery control functions, allocating and distributing various transportation resources in the most effective and rational way based on different operational conditions and environments. The standardization and optimization of processes will reduce manual intervention and improve operational efficiency and accuracy in order to ensure continuous, consistent, coordinated and economical operation for maximum production efficiency.

Visualisation of information

As an integrated information center, the connected port will focus on the acquisition, control and processing of data using short-range wireless sensors, WLAN and wide-area wireless networks. Remote information processing and exchanges with machines will nurture an efficient and integrated environment for the in-house operations of the port.

For port operations, a port’s central dispatching system and terminal production system will be integrated to strengthen the collection and management of port operational information, thereby seeking operational coordination, information sharing and dynamic production monitoring across the port.

Figure 10: Automation of port machinery

<table>
<thead>
<tr>
<th>Process and facilities</th>
<th>Ordinary terminal</th>
<th>Automatic terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container quay crane</td>
<td>Manual operation in cockpit</td>
<td>Semi-automatic fully automatic quay crane</td>
</tr>
<tr>
<td>Horizontal transportation operating equipment</td>
<td>Tractor and pallet truck</td>
<td>Auto strad and ADV</td>
</tr>
<tr>
<td>Yard operating equipment</td>
<td>Stacker and RTG</td>
<td>RMG</td>
</tr>
<tr>
<td>In-yard container stacking layout</td>
<td>Generally arranged in parallel with the quay crane to facilitate flexible RTG operation</td>
<td>Generally arranged vertically against the quay crane to facilitate flexible ADV operation</td>
</tr>
<tr>
<td>Gate</td>
<td>Serial number recognition on containers and vehicles, partly automated</td>
<td>Smarter, high-definition (HD) video recognition and 3D modeling</td>
</tr>
<tr>
<td>Terminal operation and management mode</td>
<td>Data exchange between wireless devices and the control room</td>
<td>Automatic devices managed by the control room through a smart management system</td>
</tr>
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Figure 11: The application of the intelligent terminal

Key business segments
- Smart gate
- Smart stowage
- Smart vehicle scheduling

Main functions
1. Quick access to information: fast and accurate automatic identification of the serial number of vehicles and containers by RFID technology helps the acquisition of relevant information on container shipping, and supports the dynamic management of production, yard, and port entry and exit.
2. Smart testing and analysis: remote detection of container deficiencies by video technology converts video information according to monitoring and operating needs, conducts gate operational efficiency analysis, and forecasts traffic flow.
3. Real-time interactive information: real-time interaction with e-commerce and operating systems (in the terminal and the yard, for example) through the gate system enables automatic port entry and exit routing, automatic container slot assignment, and smooth operation of the cargo handling and other operations.

Requirements
- 1. A knowledge base featuring self-improvement: bringing together and analyzing massive amounts of data on the factors impacting ship stowage, stowage rules, domestic and foreign laws and regulations on container transportation, stowage expertise, industry-leading stowage calculation models and solutions, among others.
- 2. Accurate and efficient stowage: carton volume distribution and category proportion, ports of call and other information, as well as real-time information on the stockpiling of goods, machinery and equipment status, liner routes, berths and sources of goods, are automatically combined to form a stowage plan for safe and efficient cargo shipping and maximize the loading capacity of each ship.

- 1. Real-time positioning and monitoring: real-time display of device/vehicle location within a port, multidimensional queries of device/vehicle location, status and other information, travel alarms, operation analysis.
- 2. Efficient and accurate scheduling: calculation of spatial distance based on the shipment plan, road network, block distribution and berth arrangement, using a traffic volume forecast model and a traffic flow analysis model to predict vehicle travel time and automatically send vehicle dispatch instructions, which will be optimized on an ongoing basis based on real-time monitoring of vehicle dynamics.

- 1. A knowledge base featuring self-improvement: bringing together a massive amount of data on shipping routes, domestic and foreign requirements for shipping emissions, scheduling expertise, industry-leading resource allocation, road-mapping-related mathematical models and solutions, among others.
- 2. Efficient and accurate scheduling: the travelling status of ships is matched with graphically presented, real-time data on the status of machinery and devices, berths and vehicle transport at the production site to calculate the optimal matrix of route and speed for automatic scheduling.
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Internal information networks, channel video surveillance, ship location, GIS electronic maps, ad-hoc networks and other technologies will be used to integrate fundamental data on resource management on a 4G network, achieving smart resource planning. The management of port operations will become smart through automation and the use of IT, including the use of smart gates, port guards, bulk cargo transport management and smart yard management. Access to base business data will be possible through electronic tags, video devices and portable terminals, while face recognition and location tracking and analysis, combined with broadcast and alarm systems, can support port security management and port operational decision making. This will also assist in achieving real-time and accurate production scheduling, command and coordination, cargo information processing, equipment maintenance and warning, and security monitoring.

For port and shipping logistics services, a service system of full-process logistics information will be established, providing logistics enterprises and upstream and downstream customers with a platform for multilateral collaboration and business operation, and increasing the core competitiveness of the connected port throughout the process. In customer service management, for example, the system can offer basic port information, customer service guides, port business process descriptions, and information on the application of operational procedures. A database for corporate credit information management and corporate credit evaluation can also be set up. A unified port logistics information service platform can be docked via the Internet to the business systems of logistics service providers, the government and customs, to reduce the number of intermediate nodes and simplify transit application procedures. This can help mitigate the operational complexity of business decision making and operation in multimodal transportation and transit by water. For example, in transport management, a public logistics platform relying on the Internet of Things can tag RFID to road container transport vehicles, and a sensor network can identify cargo, containers and means of transport covering the port, terminals, yards, logistics parks and other areas. This contributes to the collection and exchange of logistics data across the terminals in the port’s area.

For the regulatory services system, port and shipping regulatory information from competent government authorities can be obtained and released through an information and data interface. Network-based claim, approval, management, and other clearance support can be provided for customs, inspection and quarantine, maritime and other regulatory authorities, as well as port customers, to achieve an efficient link between the port and its regulatory authorities. In port management, for example, the single window covering the entire logistics value chain can be framed to expand port e-commerce services for logistics. The scope of full-range network application should also be extended along the port logistics value chain, where APS positioning communications, RFID technology, video analysis, and positioning and tracking analysis can be used for dynamic management of vehicles, personnel and devices that enter and exit the port. Data docking between data center systems and terminal systems means, for port business units as well as regulatory bodies, smart information collection, processing, analysis and decision-making support can be improved in the areas of logistics, clearance, trade, finance, and insurance, to name but a few.

Collaboration with the logistics sector

In connecting maritime and land transport, the terminal is aligned to multiple logistics service providers and relevant regulatory agencies. The terminal and its stakeholders all have their own objectives. Shipping companies seek larger ships, for instance, expecting the port to enhance its corresponding handling efficiency, while the terminal prefers moderate-size ships, which help it manage berths in a convenient and flexible way. Although the enterprises across a port’s supply chain are interdependent, cooperation between them is less than satisfactory. A lack of a unified goal due to differing interests, difficulties in upstream-downstream collaboration given scattered resources and multiple participants, and the lack of effective resource integration tools under agreed information standards, all play a part.

The value proposition in maritime logistics collaboration is to improve the overall efficiency and service quality of the value chain in order to reshape the terminal owner’s experience. Logistics collaboration calls for enhanced ability in three areas:

- Being “accessible” by ensuring strategic cooperation between ports and optimizing the inland multimodal transportation network to attract terminal consignors.
- Being “informed” by nurturing a port community system and pooling the business demands of all players involved in logistics to create a convenient and transparent information platform and retain terminal consignors.
- Being “value-added” by fostering innovation in logistics transaction services, using data to add customer value and improve service experience.

There is a developing trend for ports to form networks in which dominant and supporting terminals work together. An isolated transport gateway finds it hard to form a lasting competitive edge. The integration of port logistics networks relies on three aspects:

- Connection: shape the multimodal transport network covering the hinterland. In Rotterdam, different international supply chains and operating networks (such as inland terminals, port terminals and inland transport) have been integrated into a coordinated system with clear points of entry; following integration, Rotterdam harbor, Rotterdam city and surrounding ports share the same port area systems.
- Standardization: perform standardized operations and operation management, including the promotion of standardized facilities. In Germany, there is a single, common logistics park in a city or an economic zone. Each port is a DGG (Deutschen GVZ-Gesellschaft mbH) member and operates according to the same standards under the coordination of the DGG.
- Cooperation: deep water ports and inland ports can cooperate under reasonable division of labor, allowing the ports to run concurrently as a multimodal hub and a distribution center. In the European Gateway Services network of ECT ports in Rotterdam, a collection of trunk terminals, inland terminals and inland dry ports form an efficient, seamless container transportation network consisting of rail, roads, barges and feeders. Each node provides similar container logistics services, including traditional and value-added container services, as well as empty container withdrawal and return, customs and other services.

Accessible: optimization of the logistics network

Local optimization does not assure a global optimum. Convenience within a single port does not necessarily facilitate international trade across a whole region. Rather, enhanced regional competitiveness stems from a close connection between port construction and inland corridors. This cannot happen without collaboration between government, businesses and innovators.

In Australia, in none of the top five ports does the proportion of water-railway transport account for more than 15 percent of total transport. As a result of a mismatch between modern, automated port facilities and poor hinterland infrastructure, Australian Port Authorities have launched an initiative — Beyond the Port — to change the status quo. The initiative seeks to support trade by developing inland transport corridors to connect ports, trade centers, warehouses, mines and factories.

In Rotterdam, in the Netherlands, the European Gateway Services network of ECT ports is categorized into three groups: trunk terminals, inland terminals and inland dry ports. Multiple rail and barge trips, a well-developed transport network, and integrated clearance services are the keys to the success of ECT’s European Gateway Services. ECT’s E-Services platform helps integrate shipping companies, shipping agencies, freight agencies, consignors, customs, transport service providers and other participants in the network, tracking the source of goods and providing value-added information services.

In Dubai, DP World is determined to “guide future world trade” by building a connected port backed by an ecological park complex. In 2015, DP World invested US$2.6 billion in the acquisition of Jebel Ali, a free economic zone, obtaining a favorable trade environment to consolidate goods supply.
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- Cooperation: deep water ports and inland ports can cooperate under a reasonable division of labor, allowing the ports to run concurrently as a multimodal hub and a distribution center. In the European Gateway Services network of ECT ports in Rotterdam, a collection of trunk terminals, inland terminals and inland dry ports form an efficient, seamless container transportation network consisting of rail, roads, barges and feeders. Each node provides similar container logistics services, including traditional and value-added container services, as well as empty container withdrawal and return, customs and other services.
Inform: an interoperable platform backed by IT

A leading port generally positions itself as a modern logistics center and a hub due to the number of participants in maritime logistics and the presence of information silos, which results in serious information asymmetry. A terminal consignor needs to communicate with multiple parties before identifying the best logistics solution, for instance, undoubtedly lowering the efficiency of the process. Insufficient IT-driven automation is another inefficiency, where a large number of processes and orders are handled by people rather than AI. The systems of shipping companies are not yet integrated: freight agencies still use emails, phone calls and other means to obtain real-time information on space status, order confirmation, invoice processing and logistics tracking. The “single window” is an important recommendation published by the United Nations at the beginning of this century, which promotes international data sharing and automated processing to facilitate efficient international trade. The single window can take three forms: a limited single window (customs, ports, FITs, etc.), a national single window, and an international and regional single window.26 Some jurisdictions possessing leading ports, such as Singapore, the Netherlands and Germany, have established national single windows, integrating the information required for international trade, port transportation and declaration. Here in China, port cities such as Shanghai, Tianjin and Fuzhou have established relatively independent single windows, but there is neither a seamless information chain in place for maritime logistics nor an IT platform covering ports, consignors, shipping companies, transport companies and port units. P&G Customs recently opened a business data exchange interface for enterprises, which will help in developing unified data standards to make future single windows more flexible.

The establishment of an interoperable IT platform needs seamless data flows upstream and downstream of the port. A shared and interactive data center is essential in providing standardized data for participants in the ecosystem and in ensuring the timeliness and accuracy of information for all parties. Take Singapore’s PSA PortNet as an example. This IT platform provides information interoperability for ports, shipping companies, consignors, the government and transport companies, processing more than 70 million transactions on average each year.27 Similarly, through the creation of a cross-regional single window, the European Port Community Systems Association (ESPCA)28port platform established a port alliance for six major port operators, covering Germany, Britain, the Netherlands, Spain, Italy, Latvia, Belgium, Ukraine and Israel, significantly increasing trade efficiency by using a convenient information-sharing mechanism.

An interoperable information platform is essential in many ways. Such a platform can improve a port’s management and decision making, enable remote scheduling, optimize a port’s logistics processes and enhance its logistics service, and achieve seamless connectivity between the port and port-related logistics services providers and other parties.

Added value: increase innovative services for logistics transactions

Future ports will use open innovation to promote innovative services for logistics transactions. Leading FMCG company P&G has, for example, undertaken an open innovation program and transformed “R&D” (research and development) into “C&D” (connect and develop). The company has achieved great success through its information platform for the worldwide submission of innovative proposals. For ports, open innovation emphasizes collaboration between large enterprises and innovative SMEs, including the open, targeted sharing of cooperation methodology, as well as innovation in the “1 + X” model based on the main business of a port. Specifically, a port IT platform for interconnected logistics-related parties should be set up, with its accumulated data used to drive innovations in maritime logistics services, such as consolidation centers, empty container repossession, transport trailer transactions and bookings.

Figure 12: ESPCA, cross-regional port interconnection

- **Innovative services for the LCL (Less than Container Load) center:** complex inspection processes and a high cargo damage rate have become major issues for maritime logistics. In China’s hinterland market of the Yangtze River Delta, for example, general cargo damage in port inspection is estimated to reach up to 30 percent. Setting up a centralized, specialized LCL center with optimized inspection processes, in collaboration with customs, inspection and quarantine departments, can help reduce annual cargo damage by about CNY580 million. With world-class logistics infrastructure, Germany boasts a multimodal transport network with seamless connections that guarantees the shortest transit times. Meanwhile, coordinated by the DGK, each city’s logistics village is growing into a comprehensive logistics center with standardized hardware facilities and first-class IT systems, bringing together devathing)C&JL warehousing, distribution and other logistics solutions to ensure quality service and quick customer responsiveness.

- **Innovative services for empty container repospositioning:** empty container repospositioning is a critical controllable cost for ports and shipping companies. Uneven flows of empty containers arise from an import-export imbalance between different jurisdictions. A trade surplus in China and other rapidly developing countries has resulted in greater demand for empty containers among local consignees and a costly demand for carriers to send empty containers to these jurisdictions. Empty containers are even transported back and forth between adjacent ports due to information asymmetry. Partnerships with shipping companies can be used to set up empty container banks and coordinate empty container repospositioning plans between multiple carriers and reduce the costs associated with empty containers.

- **Innovative services for trailers:** for logistics companies that are small and lack information-sharing mechanisms, there is still much room for improvement in the attendance and heavy-load rates of trailers. In Shanghai, 27,000 container trucks support a throughput of 3,654 TEU, but the idle market (including resource redundancy) is valued at about CNY7 billion due to poor convergence and invalid empty runs. Future ports can provide goods-vehicle matching services through an interoperable information platform. In Rotterdam, freight agencies submit booking messages and match trailer services using Portdata, the port’s community platform. Additionally, route optimization and other value-added smart transport services can be offered. At the Port of Hamburg, a helmsman carries a smart terminal which is integrated with tens of thousands of sensors placed inside and outside the port area and in the transit base of container trucks. The device can automatically recommend the optimal route to the helmsman to mitigate bottlenecks resulting from the delay or early arrival of ships.29

- **Innovative services for booking:** insufficient IT and information asymmetry have become pain points in booking transactions. A public booking platform is an attractive prospect, but to truly change the status quo, port operators have to address a number of challenges. These include the lack of a standardized EDI format for shipping companies, leading to high docking costs; a lack of public trust among business participants; and a lack of IT and information services. Specialized LCL centers will enable efficient and effective use of empty containers, lowering the cost of empty containers and extending the “1 + X” model to bring together shipping companies; and hidden rules in the freight agency market, such as rebates. The key is to balance multiple interests; improve simplicity, integration and compatibility through standardized formats and automated processes; and bring new value to logistics participants. INTTRA, the world’s largest public booking platform, initially cofounded by the Maersk Line, P&O Nedlloyd (now acquired by Maersk), Hamburg Süd, MSC and CMA CGM, provides value-added services through a free website. It has become a network-based trading platform serving more than 50 container transport companies and more than 220,000 users, with openness and sharing as core features. In addition to e-booking services, it provides schedules of ocean-going vessels, ship redirecations, tracking and tracing of bills of lading, e-invoices and e-reports, among other services. The use of online booking platforms is expected to decrease freight contact rates and booking times by about 50 percent.30
An interoperable information platform is essential in many ways. Such a platform can improve a port’s management and decision making, enable remote scheduling, optimize a port’s logistics processes and enhance its logistics service, and achieve seamless connectivity between the port and port-related logistics services providers and other parties.

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A platform for all in the ecosystem

Trade facilitation generally addresses market access, customs performance, logistics efficiency and infrastructure, and policy environments. Remarkably, enhanced trade facilitation outpaces tariff reduction in fostering trade growth. In recent years, by simplifying internal trade procedures and consolidating business processes, the European Union (EU) has established a set of convenient automated clearance systems, and has actively cooperated with the United Nations (UN), World Trade Organization (WTO) and other international organizations, as well as major economic powers, on trade facilitation. These initiatives have played an important role in the European economy.

Trade facilitation primarily means sharing information and data to improve the business efficiency of customs clearance, tax refunds, and foreign exchange settlements. A WTO study[25] found that terminal consignors, especially SMEs, are most concerned about the cost of access to information. The linked network and information platforms of connected ports will make it easier for terminal consignors to identify business opportunities and contact parties involved in maritime logistics.

Trade facilitation also means services facilitation. It helps consignors with day-to-day business processing, such as customs clearance, foreign exchange settlement, export tax rebates and other formalities, both reducing time costs of consignors and improving the operational efficiency of government authorities. Port operators cooperate with the government, stakeholders and innovative enterprises to identify opportunities for better trade facilitation and develop personalized value-added services.

The key to improved trade facilitation is cognition and action. ITC (International Trade Centre) and the World Economic Forum have suggested that regional trade facilitation can be implemented in three phases: 

- In the preparation and diagnostic phase, the main implementer and stakeholders need to set common goals and prepare for implementation. This includes designing models of cooperation with stakeholders and obtaining local government support for the construction plan. Actions should be taken based on a realistic, objective evaluation of the local regulatory environment, operational level and infrastructure conditions. This would include an analysis of local import and export procedures and trade costs, the identification of local trade pain points and potential opportunities for improvement, and the development of targeted promotion programs based on an analysis of trade costs (such as the construction of a multimodal logistics park and the selection of a specific list of partners and cooperation models).

- In the pilot program phase, the action plan for logistics network optimization and trade costs reduction will be determined, with resources allocated accordingly. Once the program is implemented, the execution should be tracked and outcomes should be evaluated.

- In the mobilization and execution phase, the outreach program should be promoted across new areas based on the results of the pilot program.

Popularization of logistics finance

In the age of the industrial Internet, financial innovation will play a more important role, providing more efficient and appropriate services to the economy. A fast, efficient, low-cost and digitally-enabled connected port demands that financial services be integrated for trade facilitation and smart maritime logistics. With digitalization and open innovation, emerging financial technology companies will be able to provide liquidity instruments in specific areas and sectors, often overlooked by banks in the past, as well as for SMEs.

Trade finance is closely related to economic activities and trade expansion around the world. Trade growth has slowed compared with the past, with certain commodity prices falling as a normal trend. This will be a challenge for trade finance on an ongoing basis. Overall, the financial trade services market is not saturated: global exports totaled US$18.49 trillion in 2014, of which export contributed US$490.1 billion. The use of letters of credit, according to the CGFS (Committee on the Global Financial System) research statistics, covers only 11 percent of global trade, but accounts for about 45 percent of the trade market in East Asia. For ports, financial innovation can be improved in many aspects.

- The long account period reveals a huge funding gap. Traders in the Yangtze River Delta, for example, find their logistics costs accounting for 7–11 percent of trade volume, usually subject to settlement periods ranging from 30 days to 60 days. Since both trading parties are prone to default, intermediate logistics service providers are also exposed to advance repayment risk. Other SMEs, such as towing companies and logistics companies, face similar pressure on cash flow.

- Insurance of goods is valued, and financial needs emerge in many scenarios. Long transport times and frequent transfers of goods in the trade process mean that there is high consignor demand for insurance to ensure cargo safety. The marine insurance market is worth hundreds of billions of dollars a year. At the same time, as the operating model of ports, barge companies, shipping companies and other heavy assets can require a large cash flow, financial leasing is prevailing in this market.
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• Cash flows lag behind the flow of information. A significant amount of trade takes place in a port (trade payments, settlement of transportation costs and collection of tariffs) where multiple parties are involved in large-scale, high-frequency transactions. These transactions involve a large number of invoices, and it is difficult to keep all transactions paperless, which affects the efficiency of the process. In freight agency, for example, e-bank payments are even used in trading with traders, trailers and other enterprises, as the bank journal record cannot meet the requirements for corporate financial reconciliation. The main mode of transaction is credit remittance through a commercial bank. Although the IT of commercial banks can support traders in making a remittance by telegram, the complexity of material submission, the long review time and foreign exchange settlement, have greatly lengthened the time taken for traders to obtain funds. This is in addition to the uncertainties of the document review process, which forces companies to go back and forth between bank branches.

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Given channeled information and integrated business flows, logistics and trading, connected port services can, in the future, move to online payments and integrate capital flow through leveraged trade and logistics trading scenarios. At the same time, data can be leveraged to build a credit system to ensure efficient use of capital while mitigating risk. Innovation in financial services will encourage growth in areas such as personalized premium schemes, upgraded financial leasing services, and expanded financing channels. Together, these will constitute a financial ecosystem within a port.

- **Payment: channeling capital flow to improve transaction efficiency.** Through online and mobile payments, among other means, unified channels are created to streamline the transaction processes of trade and logistics services. Capital flow, in conjunction with information flow, business flow and logistics, works as a whole to enhance trade efficiency.

- **Financing: optimizing capital allocation to promote trade development.** Collaboration along the maritime logistics value chain, logistics information visualization, and port IT upgrading are the foundations of innovative financial services in a connected port. By building a credit rating system, a connected port, backed by credit, is able to offer warehouse receipt financing, confirmed warehouse financing, credit loans and other forms of financing, which will reduce the cost of access to capital, improve capital flow efficiency and fuel trade development.

- **Insurance: reducing premiums through process-wide visualization.** A connected port can pursue a credit rating system supported by big data for visualized logistics tracking and online supply chain business processing. A consignor can then choose the most convenient and reliable means of cargo insurance and use the findings of big data analysis to individualize a program for premiums that reduces insurance costs.

- **Financial leasing: seeking asset-light operation to release cash flow.** The asset-heavy nature of the port and shipping industries means much of the capital of operators and shipping companies is occupied. A connected port produces transparent capital data for the evaluation of operating loss, which provides an evidence base to help financial institutions set pricing for financial leasing. This enables all parties to move to more asset-light operations and release cash flow.

- **Asset trading: opening transactions to expand capital sources.** Financial institutions can act as partners to provide a source of funding, and a number of assets in the port and shipping sector can be secured to expand the capital sources of a connected port and build a more flexible financial ecosystem.

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**Commercializing data service**

The era of data technology is here. An Accenture survey on the contribution of the digital economy to the global economy shows that the digital economy contributed 34 percent of US GDP in 2014, and is expected to reach 39 percent by 2020. Equivalent figures in the UK and China are estimated at 33 percent and 19 percent, respectively.¹⁴

The integration of business data on production, manufacture, sales and maintenance in traditional manufacturing industries has led to productivity gains and created a new business model. In Michelin’s case, for example, tire wear data analysis helps fleet managers reduce fuel consumption and costs, and allows them to pay tire expenses on a kilometers-driven basis. Big data companies in various forms have spread out across the globe, including but not limited to business data analysis, visualized reporting, big data platforms, data storage, mining and application.

A port accumulates enormous amounts of data, including information on terminal berths, sailing date arrangements, trailer scheduling, categories and destinations of import and export goods, and transportation routes, and the volume of this data will only increase with future maritime logistics collaboration. The potential value of this data lies in mining trading and logistics information to reveal hidden features and patterns, which can facilitate trade-related decision making and create significant social value. This can include smart time arrangements for trailers’ entry into and exit from a yard, optimization of the logistics and transport routes for container trucks, support for warehouse sitting, monitoring and early warning of dangerous goods transport, category prediction for import and export goods, regional consumer demand preferences, corporate credit assessment, financing and credit. Data service innovation can improve the operating efficiency of a future port, as well as providing traders and logistics companies with more valuable decision-making support through innovative application scenarios.

Data service is a long-term project that relies on sufficient data collection, and corresponding computational and analytical skills. Data acquired within a connected port needs constant replenishment and must be complemented with integrated external resources, such as spatial geography and prices in international trade. An open data platform for industrial application design, making use of using external innovation, will better accelerate data mining and value realization for a connected port.
Commercializing data service

The era of data technology is here. An Accenture survey on the contribution of the digital economy to the global economy shows that the digital economy contributed 34 percent of US GDP in 2014, and is expected to reach 39 percent by 2020. Equivalent figures in the UK and China are estimated at 33 percent and 19 percent, respectively.38

The integration of business data on production, manufacture, sales and maintenance in traditional manufacturing industries has led to productivity gains and created a new business model. In Michelin’s case, for example, tire wear data analysis helps fleet managers reduce fuel consumption and costs, and allows them to pay tire expenses on a kilometers-driven basis. Big data companies in various forms have spread out across the globe, including but not limited to business data analysis, visualized reporting, big data platforms, data storage, mining and application.

A port accumulates enormous amounts of data, including information on terminal berths, sailing date arrangements, trailer scheduling, categories and destinations of import and export goods, and transportation routes, and the volume of this data will only increase with future maritime logistics collaboration. The potential value of this data lies in mining trading and logistics information to reveal hidden features and patterns, which can facilitate trade-related decision making and create significant social value. This can include smart time arrangements for trailers’ entry into and exit from a yard, optimization of the logistics and transport routes for container trucks, support for warehouse sitting, monitoring and early warning of dangerous goods transport, category prediction for import and export goods, regional consumer demand preferences, corporate credit assessment, financing and credit. Data service innovation can improve the operating efficiency of a future port, as well as providing traders and logistics companies with more valuable decision-making support through innovative application scenarios.

Data service is a long-term project that relies on sufficient data collection, and corresponding computational and analytical skills. Data acquired within a connected port needs constant replenishment and must be complemented with integrated external resources, such as spatial geography and prices in international trade. An open data platform for industrial application design, making use of using external innovation, will better accelerate data mining and value realization for a connected port.
Spillover effects in value innovation

The construction of a connected port is not limited to enhancing the port’s own infrastructure and IT; it will also facilitate a healthy and orderly business environment surrounding the logistics value chain and promote the evolution of the maritime logistics ecosystem. A smart and automated port will, for example, enjoy higher efficiency through supply chain collaboration, where there are capabilities and experience that can promote the optimization of the port’s collecting and distributing system and advance convenient logistics trading in the hinterland market. Trade and behavioral data accumulated in the logistics trading process lays the foundation for new data service capabilities and encourages competition among the participants along the logistics value chain.

The nature of these spillover effects mean the implementation of a single program may not bring direct economic benefits. Instead, commercial value may come from having a positive impact on other projects, such as optimizing a port network. This implies that leaders of a connected port need to look at the big picture rather than rush to obtain immediate benefits from an individual plan. These leaders must have their interests closely tied to hinterland trade, while the government and gateways also need to play an active role.

In promoting collaboration between different departments in a program, a value measurement system is needed to assess the contribution of the program to a connected port. This allows partners to reach agreement on the expected value of the plan to be executed and attracts new participants to push forward new professional services.

Figure 14: Interactions between creative services
Chapter 4

Suggestions for ecosystem players
"With the industrial revolution and the information revolution, the acceleration of technological development has made changes faster and more unpredictable than ever, yet most of the improvements are people oriented."

Dr. Liu Qianwen, Country Manager - China, Drewry

The construction of a connected port is a complex process that requires strong leadership. This may come from both government and companies, depending on the existing management scope of a port’s planning authority, as well as on the future influence of the port in the maritime logistics value chain.

According to an Accenture study of smart cities, poor execution in building a smart city is mainly due to a lack of interaction between the urban population and consumers, as well as among the city, national government and businesses. This can include ambiguous stakeholder expectations on the return on digital infrastructure investment, and conflicts with companies’ sales cycles (the construction of a smart city involves multiple departments, resulting in longer decision making cycles). A connected port and a smart city have similarities; both are based on a close collaboration between stakeholders. Construction of a connected port requires the engagement of leading companies and professional organizations in various domains, all contributing to the port’s construction goals throughout the process.

Suggestions for government

As a regional trade gateway, a port plays an important role in local economic prosperity. The government should promote the construction of an interoperable IT platform and a network of ports, including collaboration between connected ports, and a multimodal transport network between ports and key inland logistics hubs.

The construction of a connected port is a process requiring both a top-down and bottom-up approach. The top-down process needs government guidance, while the bottom-up process requires corporate engagement. Government should facilitate construction in three ways:

- Policy guidance should be provided, with efforts to identify the key barriers impeding the optimization of the inland transportation network. Connected port construction involves collaboration between businesses and multiple stakeholders, and the government needs to prepare strategic guidance on parallel development of both port and inland networks for a synergy across stakeholders. At the same time, a multiparty consultative mechanism and a unified value assessment system should be set up to spot and prioritize key issues affecting the inland transport network based on a consensus view of their potential value.

- An open and transparent investment environment should be created, and the value of an improvement plan should be subject to quantitative analysis to meet the needs of potential investors and stakeholders, while allowing private sector investment and full competition to ensure quality infrastructure.

- A unified data platform should be launched to guide cooperation between information management units, breaking down the information silos of shipping companies, shipping agencies, freight agents, consignors, customs, transport service providers and other logistics players. The platform will help improve logistics efficiency and lay the information base for subsequent open innovation.

Collaboration between government departments, including customs, inspection and quarantine, maritime and other sectors, is also vital in building a connected port. A single window is an effective IT instrument for this collaboration, reducing duplication of work between departments by using a standardized format and automated submission process. In addition to online collaboration, offline collaboration between relevant government departments is of great significance for trade facilitation. It provides the government with tools for reform, but the key to greater trade facilitation and higher maritime logistics efficiency still lies in improved managerial collaboration.
Suggestions for government

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Suggestions for ports

Since different ports have different environmental backgrounds and objectives, the development strategy for the construction of each connected port should be chosen in line with its particular circumstances. Looking at both existing management operations and the future vision for ports, port managers can be divided into four categories based on two dimensions (whether responsible for port operations, and with or without influence in, or control over, relations with terminal consignees): port operators, shipping logistics integration service providers, landlord port managers and industrial cluster service providers.

A port needs to consider its own endowments and its competitive environment for appropriate positioning. A connected port is a product of multilateral collaboration, rather than the output of a single party, and any port can turn smart if eligible. The difference lies in the distinctive challenges faced by various types of port enterprises and their individual journey toward tapping potential opportunities and conquering challenges.

Ports with different positioning face different challenges:

- Port operators are often targeted at leading terminal operational efficiency, but past success factors may not sustain the port in the future. These operators face many challenges affecting trade facilitation, such as inland transport networks.
- Shipping logistics integration service providers require the ability to integrate resources. Whether to vertically integrate the upstream supply chain through an independent port or to adopt a strategic collaboration approach, these providers need a supporting IT platform that covers all parties involved in logistics.
- Landlord ports are not directly involved in port operations and are highly dependent on port operators. As a result, major changes at the terminal operations level are not easy to implement and require an effective consultation mechanism.
- Industrial cluster service providers can be viewed as an extension of landlord ports. They advance industrial clusters through value-added services, while the clusters ultimately depend on a favorable logistics environment, stressing the need for leading port operators, developed inland transportation networks, and IT platform support.

Cooperation and competition

Competition drives iterative updates of the maritime logistics ecosystem while cooperation serves to create value in a more favorable way. Ports should avoid low-level competition. Renée Mauborgne and W. Chan Kim, both professors at the INSEAD Business School, spent five years studying companies characterized by sustained high growth, and found all of these high-performance companies upholding the strategic logic of "value innovation," which means shifting strategic focus from competitors to identifying valuable new markets. Widespread globalization and digitization means competition between ports will be extended to the global network and ecosystem to which the port belongs.

The most direct form of cooperation is the exchange of information. Information shared between ports and ships includes shipping schedules, arrival time, departure time, loading information and hull materials, for example. This information can support wharves in developing operating plans in advance, coordinating resources, improving the turnover of ships and enhancing the utilization of port resources. Shipping companies, freight agencies and ports can share data on consignees' imports and exports and cargo information, helping shipping companies arrange space, depots and empty containers, and assisting terminals in effectively carrying out container recovery.

Cooperation should follow the principle of reciprocity, acknowledging the unified value assessment system for connected ports and establishing cooperation based on a common goal. In response to ever-changing market demands and customer needs, ports and other parties need to emphasize capacity building in five areas: information sharing as the basis, win-win cooperation as a means, integration and optimal allocation of resources, risk controls and benefits distribution mechanisms for effective management.

- Information sharing: Standardized business processes and information systems for the port, with internal information subject to unified integration to establish an information processing platform, simultaneously connected with the information systems of upstream and downstream enterprises along the supply chain for internal and external information accommodation to support resources coordination across the supply chain.
- Win-win cooperation among participants: A port and participating parties will jointly develop a coordination mechanism. In the course of business operations, the port should, according to the business objectives of the parties involved, refer to the coordination mechanism to provide convenient conditions for all parties, ultimately offering satisfactory services to customers.
- Integration and coordination of resources: In the context of real-time share information from multiple parties, a port should integrate resources to maximize the benefits of the supply chain through dynamic programming for service portfolios, transport routes and supply-demand adaptation. This will ensure resources are fully utilized and reduce the overall time and cost of the logistics chain.
- Risk prediction and control: Any a bnormal node on aport's supply chain will affect its operation. As dynamic changes in market competition and customer demand bring increasing uncertainties, the supply chain should be able to conduct risk prediction and control, developing a management mechanism for supply chain collaboration through day-to-day accumulation.
- Benefits distribution mechanisms: With multiple parties involved in complex business relations, a port will face a challenge in dealing with issues related to the distribution of benefits among related parties. This requires unceasing efforts from the port to address the underlying cause and propel the evolution of the supply chain toward a system that meets market demand.

### Figure 15: The different roles of the port leader

<table>
<thead>
<tr>
<th>Responsible for port operations</th>
<th>Without influence on, or control over, relations with terminal consignees</th>
<th>With influence on, or control over, relations with terminal consignees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port operators</td>
<td>Providing professional collecting and distributing services for ports, improving the overall service efficiency through smart and automatic terminals and optimal construction of other port networks. For example, automated terminals at the Shanghai Port.</td>
<td>Shipping logistics integration service providers Integrating logistics services for terminal consignees to enhance efficiency throughout the process of booking, transportation, customs clearance and handling. For example, DP World is expanding hinterland logistics facilities by, acquiring the free economic zone Jebel Ali in Dubai to attract sources of goods, jointly constructing logistics facilities with UPS, backed by DP World’s gateway in London.40 The company is enhancing its maritime influence through its port network consisting of 70 wharves around the world.41</td>
</tr>
<tr>
<td>Landlord port managers</td>
<td>Providing port development and planning strategy, introducing leading logistics service providers to accelerate the construction of a high-quality and efficient logistics network and port infrastructure and create a competitive port environment. For example, the Port of Hamburg has extended its Zone I (Moorburg), promoting excellent connections between the terminal and shipping lines, the rail network and highways.42</td>
<td>Industrial cluster service providers Providing professional industrial value-added services, such as warehouse services necessary for car assembly platforms, to attract new logistics service providers or manufacturers, further facilitating cooperation between the logistics industry and the manufacturing industry. For example, Rotterdam plans to build a synthesis gas gathering center running on bio-fuels, coal and oil residues to better support the petrochemical industry.43</td>
</tr>
</tbody>
</table>

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39
Cooperation and competition

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The report is jointly prepared by Accenture and SIPG

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SIPG’s vision is to become a globally leading port operator and port logistics services provider, and is committed to the development of Shanghai as the international shipping center, facilitating global trade and development. SIPG also strives for being an operator of “connected, green, technological and efficient port”, and facilitate the upgrading transformation of the port functions, realizing sustainable development.

SIPG cooperates with partners in optimizing ports and supply chain logistics, aiming continuous enterprise growth, customer service value enhancement, and positive contribution to both the society and the larger economy.

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